Space Weather Technical Forecast

Issued on Sunday, 20 March 2022 at 12:44 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Reduced risk of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar Activity has been Low over the past 24 hours, with two minor C-class flares. One originating from AR2965 (which has now rotated off disc) in the northwest quadrant. The second C-class flare originated from a small and simple Axx sunspot in the north, just east of the meridian, which peaked at C4.6 at 20/0745UTC. There was a filament eruption associated with the C4.6 flare, which may produce a CME, although awaiting imagery for further analysis. There are currently two newly numbered sunspots on the visible disc. New region AR2972 in the southeast is a Cro/Beta, which has shown some growth in its intermediate spots. AR2973 in the northeast has continues to emerge and has been classified as a simple Bxo/Beta configuration. There are currently 2 un-numbered sunspots, which are both small and simple Axx/Alpha spots.

No Earth-directed CMEs were observed on available imagery.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by DSCOVR at L1, remained at background levels ending the period near 300 km/s. Density was at average levels before increasing above average by the end of the period, with a peak of 20ppcc at 20/0842UTC. The IMF, Bt, was weak for much of the period before increasing to around 10 nT towards the end of the period. The north-south component, Bz, was weak and ranged between +6/-7 nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background. The high energy electron flux (greater than 2 MeV) has been at generally moderate levels, peaking at 327 pfu at 19/1945 UTC. The 24-hour integrated electron fluence was well below the Active (1e8 integrated pfu) threshold, with a steady trend. Observed fluence at 19/2359 UTC was 5.97e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be at mostly Low or Very Low levels, with the reduced risk of M-class flares with 2965 now rotated off the disc in the northwest.

Solar Wind / Geomagnetic Activity: Solar winds are currently at background levels, they are expected to increase on day 1 (20 March) mostly likely due to a HSS from CH66/-, although this is low confidence.

Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 1-3). The HSS arrival may give the slight chance of Active (Kp 4) mainly on Day 1 (20 March). During days 2 to 4 (21-23 March) geomagnetic activity is expected to return to mainly Quiet.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain predominantly at background levels. The high energy (greater than 2 MeV)

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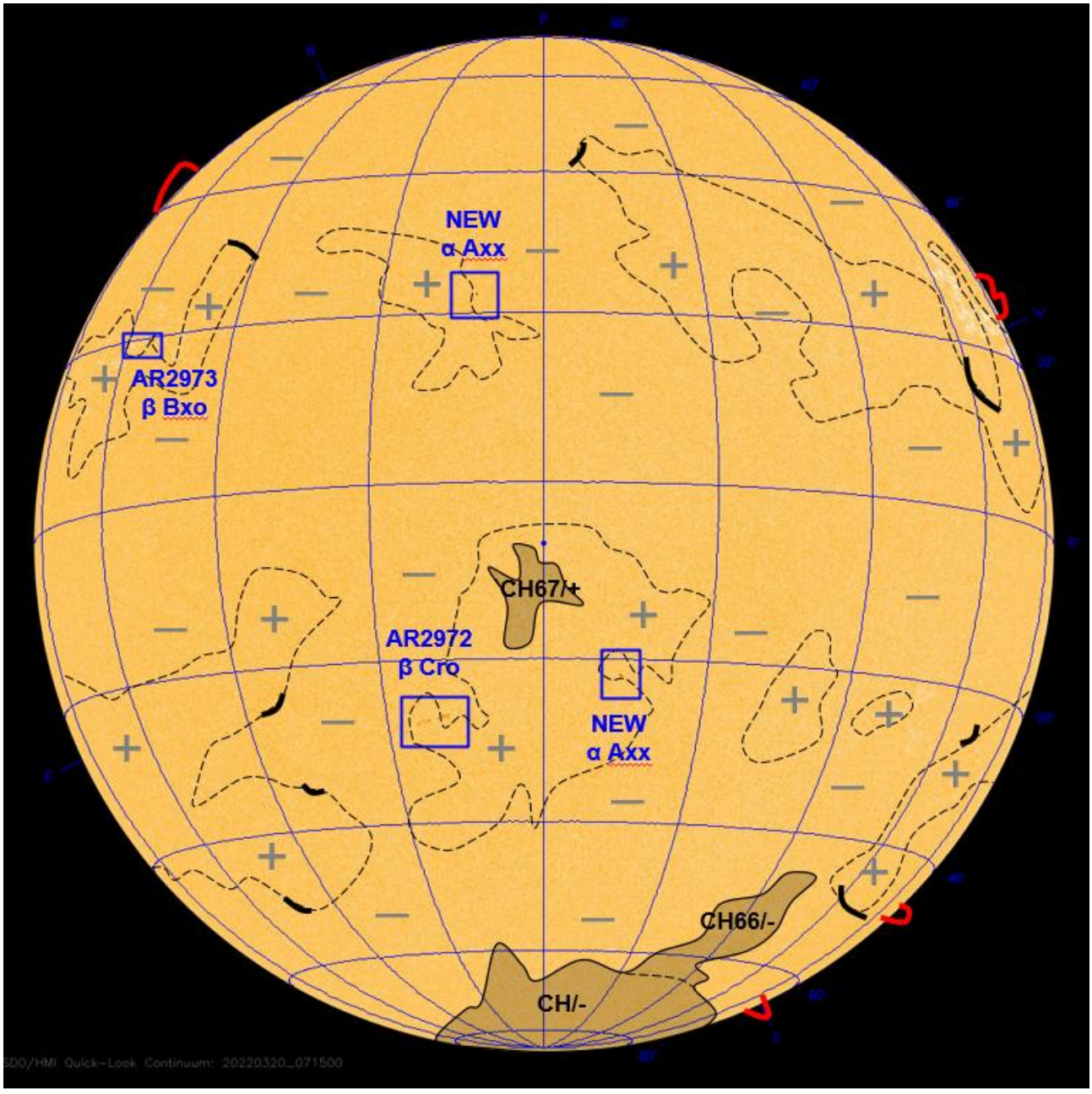
electron flux is currently at predominantly moderate levels. Further enhancement in the near term is unlikely. A combination of a possible CME and HSS arrival on Day 1 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible from Day 2 (21 March), with a rise also possible in the associated fluence level at this time, although this is low confidence due to uncertainty in the CME/HSS forecast. Fluence levels are expected to remain below 1e8 integrated pfu Active level.

Figure 1. Solar Analysis Valid 20/0715 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are currently at background levels, near 300km/s. They are expected to rise slightly on Day 1 (20 March), perhaps to around 400-450 km/s, due to a possible coronal hole high speed stream, which may arrive during Day 1 from CH66/-, a northern extension of the southern polar crown coronal hole. However, confidence is low regarding this feature as there are differences from the previous rotation. No wind speed increase has yet been detected at STEREO-A.

Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 2-3) to start. The HSS arrival will give an increased likelihood of Active (Kp 4) intervals on Day 1 (20 March). with a reduced risk of a G1/minor storm (<20%). From days 2 to 4 (21st-23rd) geomagnetic activity is expected to return to predominantly Quiet.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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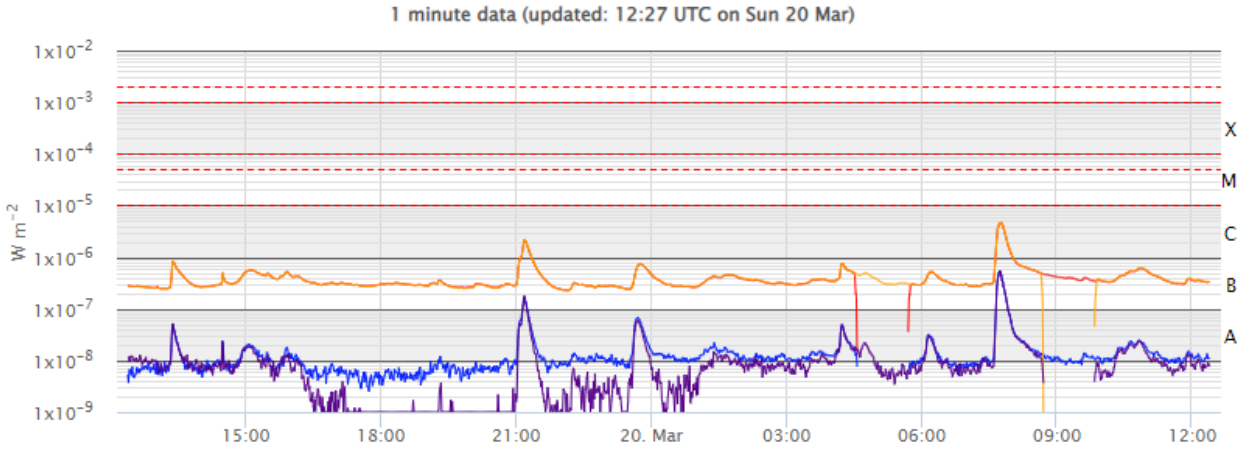
Radio Blackouts - X-Ray Flares:
Solar Activity has been Low in the past 24 hours, with only two minor C-class flares. One minor C-class flare (C1.2) originating from AR2965 in the northwest, which has now rotated off the visible disc. The second flare, was a C4.6 at 20/0745UTC, which originated near a simple Axx/Alpha sunspot located in the north, just east of the meridian. New region AR2972 in the southeast is a Cro/Beta, which has shown some growth in its intermediate spots. AR2973 in the northeast has continued to emerge and has been classified as a simple Bxo/Beta configuration. There are currently 2 un-numbered sunspots on the disc, which are both small and simple Axx/Alpha spots.

STEREO-A imagery shows possible returning regions which may rotate onto the east limb over the next few days.

Solar activity is forecast to continue mostly Very Low or Low, with a reduced risk of M-class now that AR2965 has rotated off the visible disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	5	2	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2: GOES-16 X-Ray Flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES-16 is currently at background levels, and is expected to remain at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

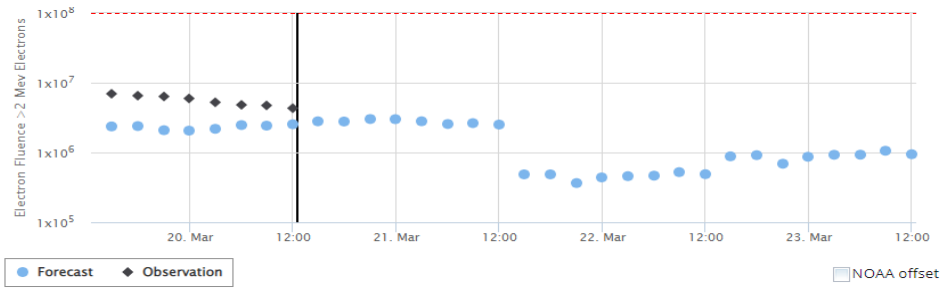
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GEO by GOES-16 is currently at predominantly moderate levels. Further enhancement in the near term is unlikely, with no recent significant wind speed enhancements which would have caused charging. A possible HSS arrival on day 1 (20 March) is likely to keep flux levels suppressed at that time. A rise is then possible on Days 2-4 (21-23 March) if the wind speed does increase, once any geomagnetic effects wane.

The associated fluence is expected to stay well below the Active (1e8 integrated pfu) threshold for much of the period. A rise is possible on Day 3 or 4 (22-23 March), although this is low confidence due to uncertainty in the CME/HSS forecast. REFM is currently underestimating the fluence level - it is probably providing reasonable guidance until Day 3 (22 March) however.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM electron fluence – observations and forecast.



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